EXHIBIT A
PART 3 OF 3

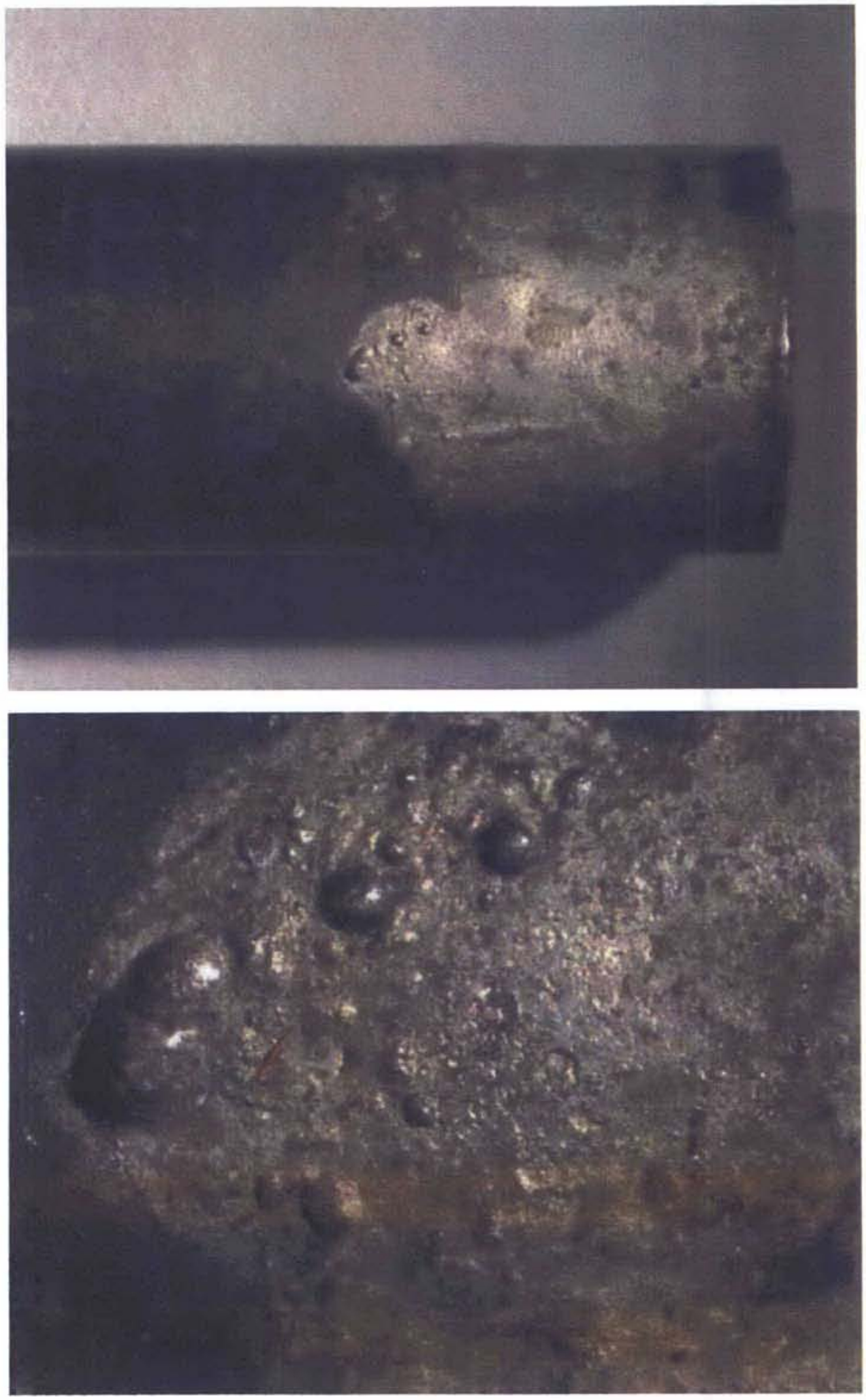


Figure 24. Stereomicroscope images of Joint Section 3 showing the solder remaining on the outer surface of the copper tube.

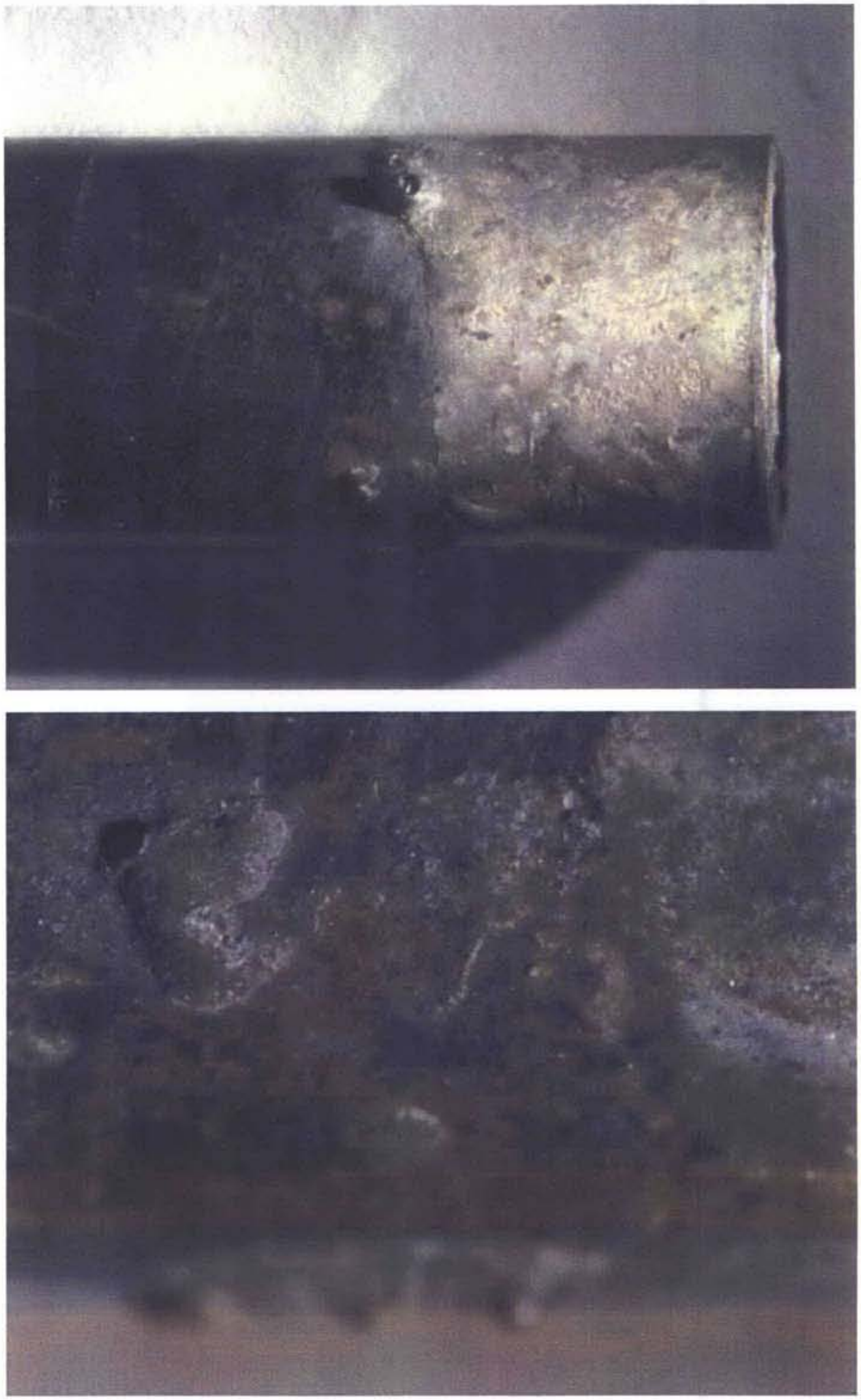


Figure 25. Stereomicroscope images of Joint Section 3 showing the solder remaining on the outer surface of the copper tube.

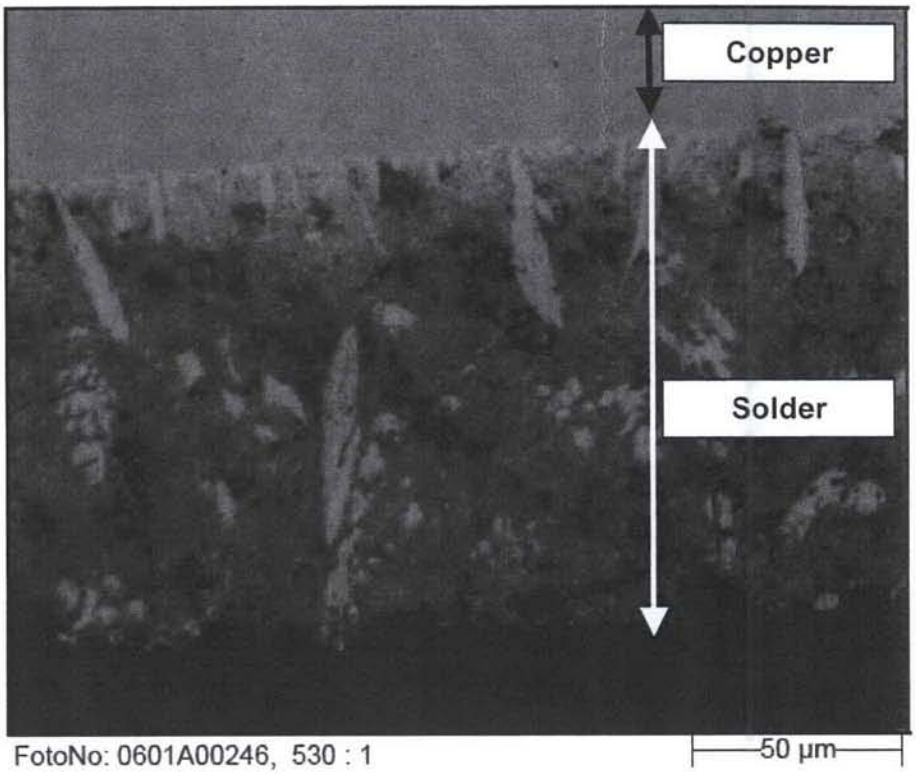


Figure 26. Optical photomicrograph of the cross-section of Joint Section 3 showing the amount of solder remaining on the copper tube.

Joint Section 4

Joint Section 4 refers to the female brass compression fitting that was soldered to the copper tube Joint Section 3. A stereomicroscope image of Joint Section 4 is shown in Figure 27. A backscattered SEM image of the inner surface of this fitting is shown in Figure 28. EDS analysis was performed in the regions outlined by red boxes #1 and #2. The spectra acquired from this analysis are shown in Figure 29 and Figure 30. As with the other brass fitting, the presence of tin on the surface is indicative of a surface film of solder, whereas the copper and lead are from the brass fitting. Figure 31 contains optical photomicrographs showing the polished cross-section of Joint Section 4. The thickness of the solder residue on the inner surface of the brass fitting is much less than that found on the copper fitting. This finding is similar to that for other brass fitting: Joint Section 2.

Figure 27. Stereomicroscope image of Joint Section 4.

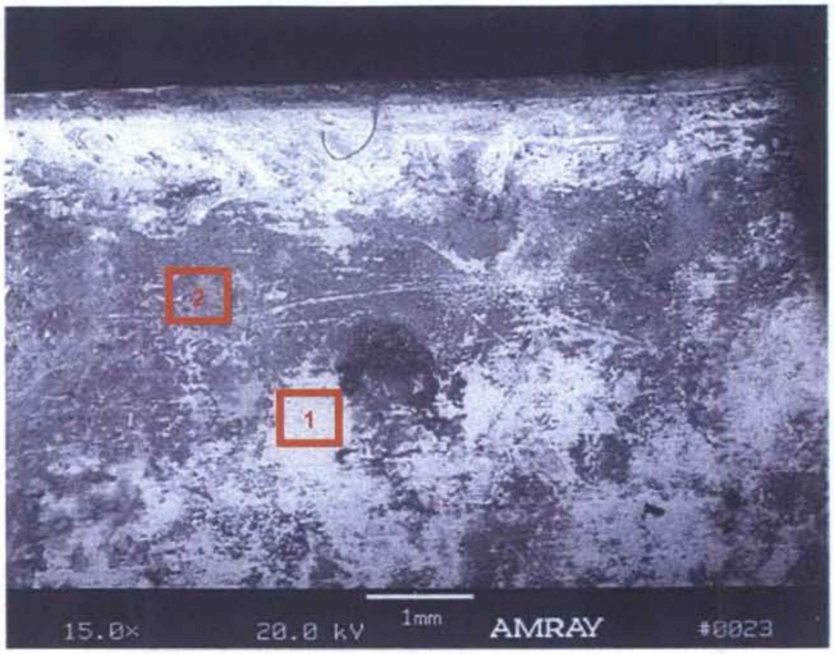


Figure 28. Backscattered electron image of Joint Section 4. EDS spectra from the areas denoted by boxes 1 and 2 are shown in Figure 29 and Figure 30.

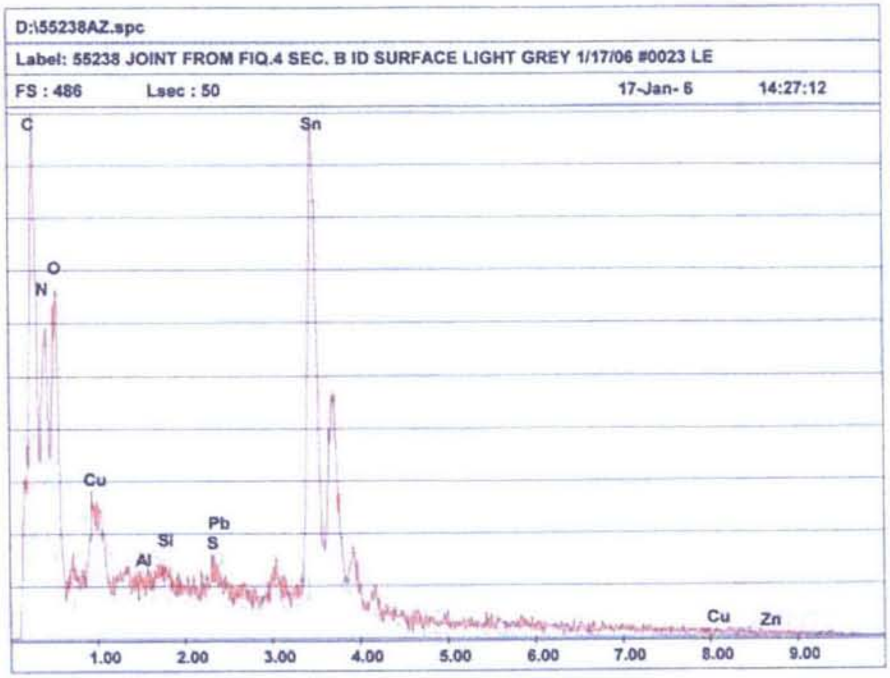


Figure 29. EDS spectra acquired from the region denoted by red box #1 shown in Figure 28.

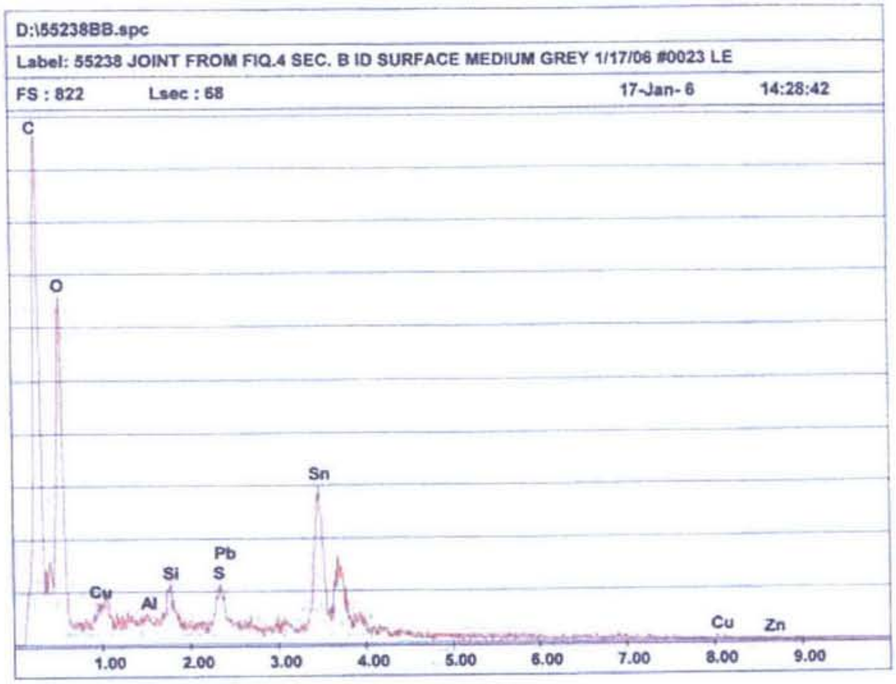
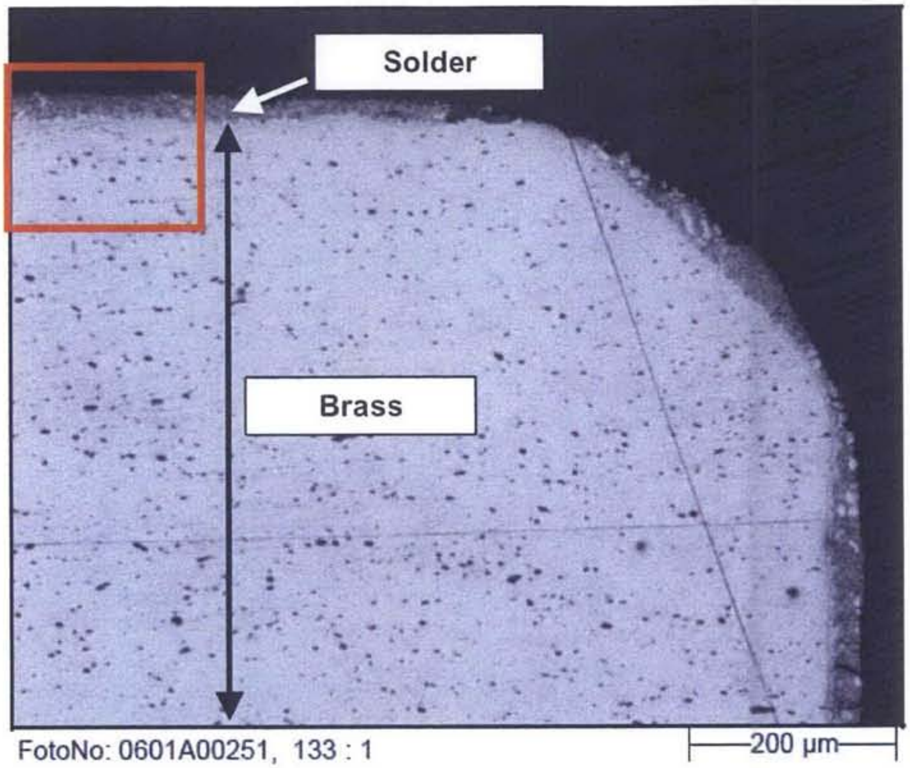


Figure 30. EDS spectra acquired from the region denoted by red box #2 shown in Figure 28.

March 7, 2006



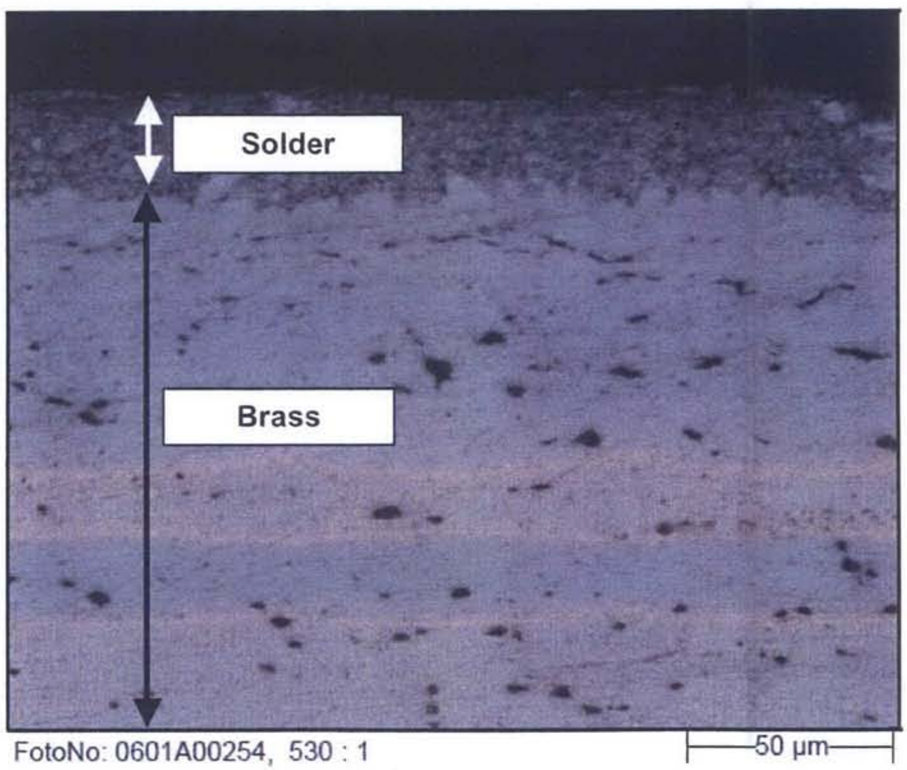


Figure 31. Optical photomicrographs showing the cross-section of the brass fitting, Joint Section 4.

Discussion

The key results from the analyses presented in the previous section can be summarized as follows:

1. Both joints that separated were comprised of a copper tube soldered to a leaded-brass fitting.
2. The solder was a lead-free, tin-based alloy with a small amount of copper, which is consistent with the type of solder that Mr. Kemp claims to have used.
3. A thick deposit of solder was present on the copper tubes, whereas there was significantly less solder residue on the corresponding brass fittings.
4. Lead was detected in the solder deposit on the outer surface of the copper tubes and the inner surface of the brass fittings.
5. A ridge of solder on one of the copper tubes showed no evidence of melting.
6. One of the separated joints was part of a threaded compression fitting attached to a flexible hose. This fitting could easily have been removed by simply unscrewing the threads.

As mentioned in the introduction of this report, it is apparent that two conditions must be met to separate a soldered joint. First, the joint must be heated to a temperature sufficient to melt the solder. Second, a force must be applied to the joint to parallel to the pipe axis such that the opposing joint sections are pulled away from each other.

In the case where a plumber used a torch to supply the heat, the torch would have been directed onto the fitting until the solder reached its melting point. The joints would then have been pulled apart and the plumber would likely remove the excess solder from the copper tube using a wet towel or rag while the solder was molten. It is important to remove the excess molten solder so that the joint can be soldered again in the future. The plumber will typically remove the excess solder from the separated joint while the solder

is molten; otherwise, the joint must be heated again at some point in the future to remove the excess solder.

Consider Joint Section 1, which is the copper tube with the ridge of solder. It is apparent that this ridge was not removed by a plumber after the joint was separated, which is not consistent with a plumber that is preparing a joint for future use. It is also apparent that this ridge of solder was not molten during the separation of the joint, and a plumber would typically supply sufficient heat to melt the excess solder to make it easy to remove. With respect to Joint Section 3, which is the copper tube that was joined to the brass compression fitting, there was a considerable amount of excess solder found on the copper tube, indicating that the solder from the original joint was not removed after the joint was separated. Also, it would not have been practical to de-solder this joint since unthreading the compression fitting could have easily separated it.

Therefore, the following findings are inconsistent with common industry practice when using a torch to separate the soldered joints:

1. The ridge of solder on the copper tube that did not melt during or after the separation of the joint.

2. The considerable amount of excess solder present on the copper tubing.

3. The separation of a soldered joint that could have readily been removed by unthreading a compression fitting.

Now consider the possibility that heat from the house fire resulted in the separation of the soldered joints. This possibility leaves the following questions unanswered:

1. Why did the ridge of solder on Joint Section 1 not melt?

2. Why did only two of the soldered joints become separated?

3. Why was most of the solder residue present on the copper tubes and not the brass fittings?

4. What was the force that separated the joints once the solder melted?

The first three questions can be answered by considering the metallurgy of the copper/solder/brass joint. This joint consists of copper and brass bonded by a thin layer of solder. The solder in this case was predominantly a tin/copper alloy. Since copper has limited solid solubility in tin, the microstructure of this alloy consists of two distinct phases: η (50:50 copper:tin) and tin, as indicated by the copper-tin alloy phase diagram in Figure 32. As previously shown, the brass in both fittings contained lead as a distinct, pure lead phase. Therefore, at the brass/solder interface, essentially pure tin is in intimate contact with pure lead.

The lead-tin alloy phase diagram shown in Figure 33 shows the consequences of this metallurgical coupling. As shown from this diagram, an alloy of lead and tin has a lower melting point than either of the pure metals. This diagram also shows that if a piece of pure tin is placed in intimate contact with a piece of pure lead and the temperature of this couple is increased, a layer of liquid metal will with a composition of 74% tin, 26% lead will form at 183 °C (361 °F). The same is true at the solder/brass interface on a microscopic level. Everywhere lead from the brass is in intimate contact with the tin phase in the solder, a film of liquid metal will form when the temperature is 361 °F or higher. Therefore, the region of solder in contact with the brass surface has an effective melting point that is 57 °F to 79 °F lower than the bulk solder alloy (418 °F - 440 °F).

This effect is shown schematically in Figure 34, and it can be used to answer the first three of the four questions presented above. First, because the solder only melts at the brass/solder interface, the joint can be separated without melting the most of the solder. Therefore, Joint Sections 1 and 2 can be separated without melting the solder ridge around the copper tube. Second, since the brass/solder interface melts at a lower temperature, the brass/copper joints will separate before the copper/copper joints. Third, since the solder only melts at the brass/solder interface, the majority of the solder is left on the copper tube.

Finally, in order to answer the fourth question, we must consider the pressure inside the water pipes during the fire. Because a drain was not installed in the sink, Mr. Kemp indicated that he would not have bled air from the water lines going to the sink. Thus, at the beginning of the fire the water lines under the sink would have been pressurized because the water was turned on but

filled with air rather than water. The ignition of portions of the wood of the kitchen sink cabinet nearby indicates that temperatures in the region of the disconnected water pipe were above 361 °F, which is sufficient to melt the solder at the brass interface as indicated above. The joints would have come apart from internal pressurization of the pipes or mechanical loads placed on the joints as components moved during the fire.

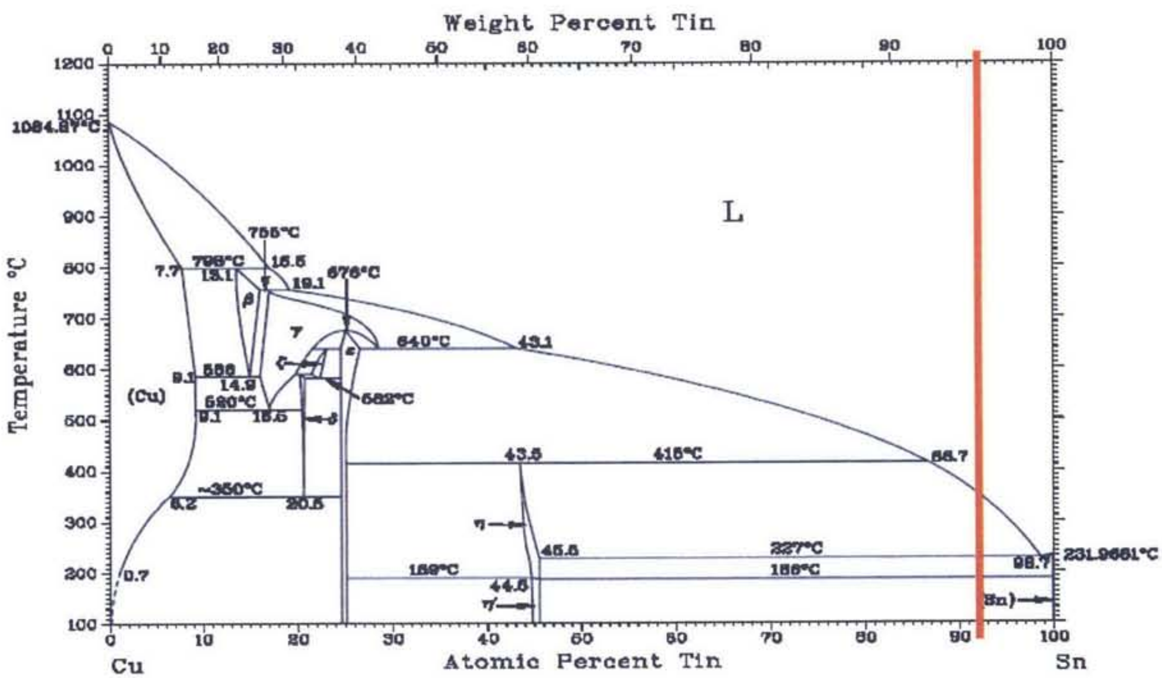


Figure 32. Copper-Tin alloy phase diagram. The red line indicates the approximate composition of the "100% Watersafe" brand solder used by Mr. Kemp.

March 7, 2006

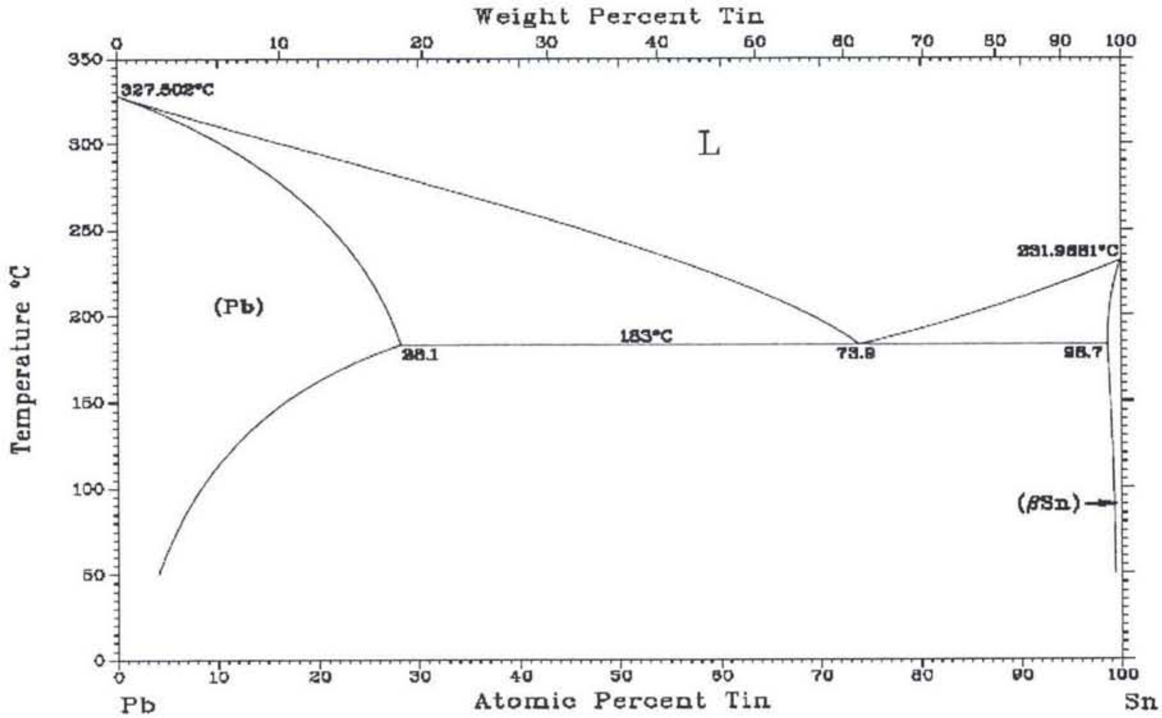


Figure 33. Lead-Tin phase diagram.

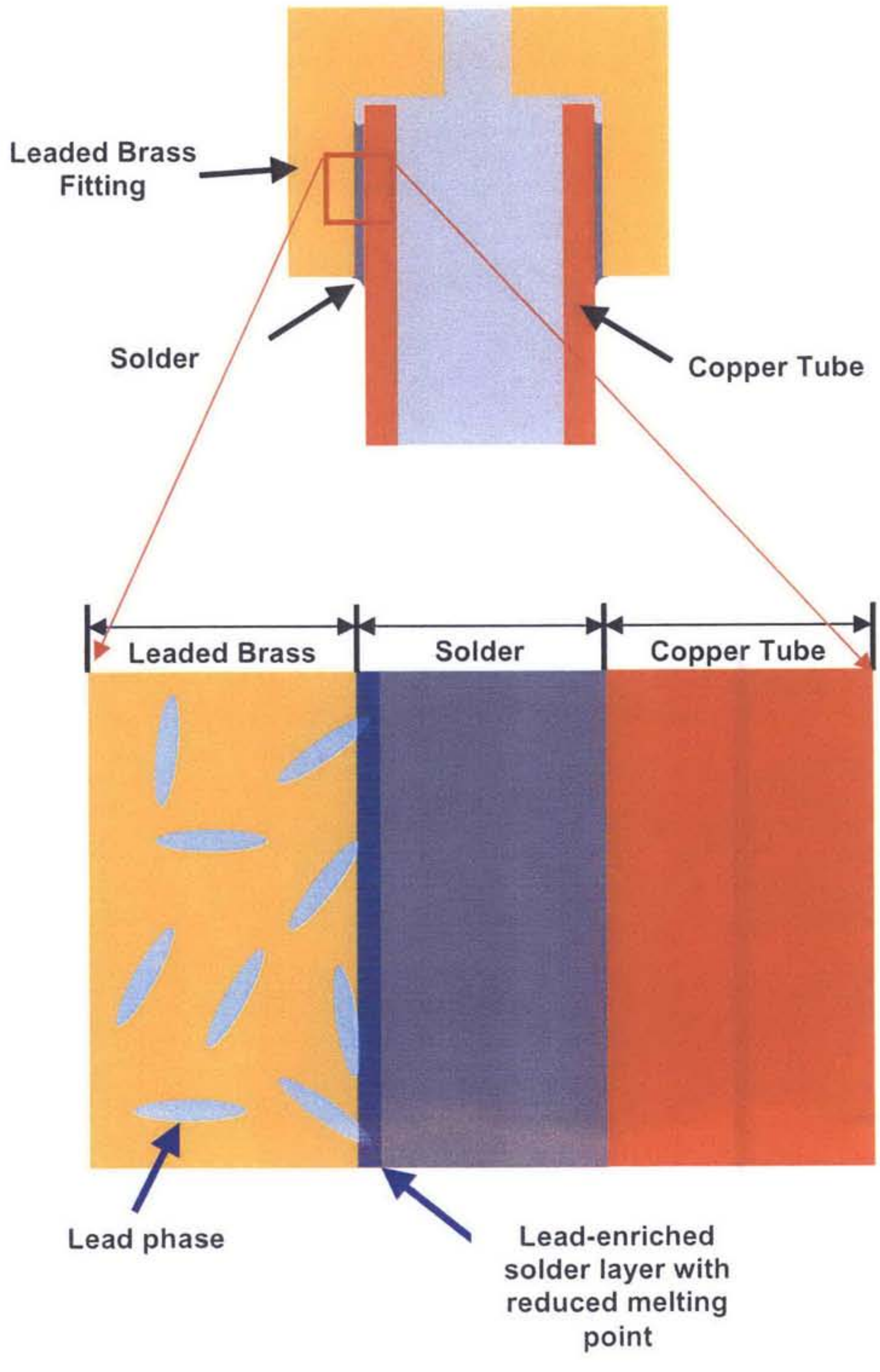


Figure 34. Schematic of a leaded brass fitting soldered to a copper tube.

Conclusions

The opinions and findings in this report were reached to a reasonable degree of scientific and engineering certainty based on information available to date. A summary of the findings and opinions reached in this report is listed below:

1. At the time the fire began, all joints of the water piping were intact.
2. The heat from the fire was sufficient to melt the solder at the copper/brass interface, but not the copper/copper soldered joints.
3. Pressure within water line provided the force necessary to separate joint between the copper tube and the brass valve when the solder melted.
4. The separation of the joint between the copper tube and the brass compression fitting followed. Either the weight of the brass valve/copper tube assembly or the movement of components during the fire could have provided sufficient force to separate this joint once the solder melted.

If additional information becomes available or additional analysis is performed, I reserve the right to revise these opinions.